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INTERCHANGEABLE EAR HOOKS FOR OPEN-EAR AUDIO DEVICE SYSTEM

ABSTRACT OF THE DISCLOSURE

An audio device system includes a pod and an ear hook. The pod houses at least a portion of a bone conduction transducer (“BCT”) and includes a first attachment mechanism disposed therein. The ear hook is configured to extend at least partially around a rear portion of an ear of a user and to maintain the BCT in a substantially fixed position in direct contact with the ear of the user. The ear hook may have first and second ends, an opening positioned between the first and second ends, and a second attachment mechanism removably engageable with the first attachment mechanism of the pod. The BCT may be exposed through the opening in the ear hook.

BACKGROUND

Headphones producing bone conducting audio cause vibrations in a user’s bone or cartilage. The transducers vibrate the user's inner ear indirectly via vibrations in the user's skull or other bones or cartilage in the user's head proximate to where the transducers are positioned. Sound is perceived by the user primarily via the cochlea in the user's inner ear while bypassing the user’s ear drum. If the bone conducting transducer does not make adequate contact with the user's skull, sound quality is lost.

BRIEF SUMMARY

According to one aspect of the disclosure, a pod may house at least a portion of a bone conduction transducer (“BCT”) and further includes a first attachment mechanism disposed therein. In this disclosure, the bone conduction transducer is not limited to transmitting sound through bone, but further includes transmission of sound through cartilage, such as the pinna of the ear of a user, as well as transmission of sound through a combination of bone and cartilage. However, for ease of discussion, the transducer will continue to be referred to

as a BCT. The ear hook may be configured to extend at least partially around a rear portion of an ear of a user and to maintain the BCT in a substantially fixed position in direct contact with the ear of the user. The ear hook can include first and second ends, an opening positioned between the first and second ends, and a second attachment mechanism that is removably engageable with the first attachment mechanism of the pod. The BCT may be exposed through the opening in the ear hook.

In one example of this aspect, the ear hook may be C-shaped and include a top portion that is configured to rest atop of an ear of a user and a bottom portion that is configured to be positioned adjacent a bottom portion of the ear of the user. Additionally, the ear hook can be configured to position the BCT adjacent a rear of the ear of the user. The hook may be comprised of a material having a density greater than 1175 kg/m³.

In another example, the second attachment mechanism may be a protrusion and the first attachment mechanism is a retaining channel that is sized to receive and secure the protrusion within the retaining channel. Alternatively, the first attachment mechanism may be a protrusion and the second attachment mechanism may be retaining channel sized to receive and secure the protrusion within the retaining channel.

In another example, the audio device system may further include a pendant physically and electrically connected to the audio device. The pendant may be configured to provide a weighted force against the BCT so as to increase the contact force between the BCT and the user.

In another example, the pod, the ear hook, and the BCT may respectively be a first pod, a first ear hook, and a first BCT. The audio device may further comprise a second pod that houses a second BCT, and a second ear hook that is removably engageable with the second pod.

According to another aspect of the disclosure, a pod includes an outer housing, a BCT and a pod attachment mechanism. The outer housing may include first and second sidewalls. The BCT may be at least partially disposed within the housing. The pod attachment mechanism may be disposed adjacent one of the first and second sidewalls of the housing and the pod attachment mechanism may be removably engageable with a hook attachment mechanism. The engagement of the pod attachment mechanism and the hook attachment mechanism can secure the pod in a substantially fixed position adjacent an ear of a user and position at least a portion of the BCT in contact with the user.

In one example of this aspect, the elongated channel may be configured to extend around at least a portion of the ear of the user. The channel may have a first channel sidewall and an opposed second channel sidewall. The opening in the channel may be sized to receive at least a portion of the pod. The hook attachment mechanism may be disposed on one of the first and second channel sidewalls. In one example, the hook attachment mechanism may be a protrusion and the pod attachment mechanism may be a retaining channel sized to receive and secure the protrusion within the pod attachment mechanism. Alternatively, the pod attachment mechanism may be a protrusion and the hook attachment mechanism may be a retaining channel sized to receive and secure the protrusion within the retaining channel.

In some examples, the hook attachment mechanism is a first plurality of hook attachment mechanisms and the pod attachment mechanism is a plurality of pod attachment mechanisms.

According to another aspect of the disclosure, an audio device kit includes a pod, a first ear hook and a second ear hook. The pod may house a bone conduction transducer and have a first attachment mechanism coupled thereto. The first ear hook may have a first size, a first shape, an opening sized to receive at least a portion of the BCT therethrough, and a second attachment mechanism that is complementary to the first attachment mechanism. The first

ear hook may be configured to extend around a rear of an ear of a user and to maintain the at least a portion of the BCT in a substantially fixed position in direct contact with the user. The first ear hook may be configured to be removably engageable with the first pod. The second ear hook may have a second size, a second shape, an opening sized to receive at least a portion of the BCT therethrough and a second attachment mechanism complementary to the first attachment mechanism. The second ear hook may be configured to extend around the rear of the ear of the user and to maintain the at least a portion of the BCT in a substantially fixed position in direct contact with the user. The second ear hook may be further configured to be removably engageable with the respective first pod. At least one of the second shape and the second size of the second pair of ear hooks differs from at least one of a corresponding the first size and the first shape of the first pair of hooks.

In one example of this aspect, the first ear hook is removably engaged with the first pod and at least a portion of the BCT is exposed through the first ear hook. The first ear hook may further include an opening. When the first ear hook is removably attached to the first pod, the BCT may extend through the opening.

In another example, the second attachment mechanism of the first and second ear hooks may be a protrusion and the first attachment mechanism of the pod may be a retaining channel sized to receive and secure the retaining members of the first and second ear hooks within the retaining channel. The first opening may be at a first position on the first ear hook and the second opening may be at a second position on the second ear hook. The first position may be different than the second position.

In another example, the first size and the second size may be the same size. Alternatively, the first size and the second size are a different size.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a front perspective view of an audio device system according to aspects of the disclosure;

FIGURE 2A is a side perspective view of an example ear hook of the audio device system shown in FIGURE 1;

FIGURE 2B is a side perspective view of an example ear hook of the audio device system shown in FIGURE 1;

FIGURE 3 is an exploded partial side perspective view of an ear pod and ear hook of the audio device system of FIGURE 1 according to aspects of the disclosure;

FIGURE 4 is a side perspective view of the ear pod of FIGURE 3 according to aspects of the disclosure;

FIGURE 5 is a view of the assembled ear hook and pod of FIGURE 1 according to aspects of the disclosure.

FIGURE 6 is a schematic plan view of the ear hook of FIGURE 3 according to aspects of the disclosure;

FIGURE 7 is a front plan view of an example use of the audio device system in use according to aspects of the disclosure;

FIGURE 8 is an enlarged view of the ear hook of FIGURE 1 positioned around the ear of a user; and

FIGURE 9 is a perspective view of components of an audio device system according to aspects of the disclosure.

DETAILED DESCRIPTION

The technology relates to interchangeable ear hooks for a modular wearable open-ear audio device system. The open-ear audio device system may include one or more ear hooks and a

bone conduction transducer (BCT) for bone conducting audio capabilities, as well as a weighted pendant. The BCT is coupled to the body of a user in order to transmit vibrations and therefore requires a decent contact force with the body in order to achieve high quality audio. Ear hooks can be used to attach and secure the BCT to the ear of a user. But, due to the variety of ear shapes and sizes, one size of ear hook may not be suitable to provide both comfort and good audio conduction for all users. To address this, a modular audio device is disclosed that can accommodate the different shapes and sizes of ears of potential users, while maintaining good audio coupling of the BCT. Particularly, the BCT of the audio device is designed to removably attach to ear hooks of varying sizes. This can provides users with the ability to select an ear hook size and shape that provides enhanced comfort and maintains good audio coupling of the BCT while in use.

Each ear hook of the audio device may be designed to ergonomically fit on the user's ears. The ear hook may be C-shaped and worn such that the ear hook curves along the back of the user's ears. When worn, the ear hook rests on the top of the user's ears and can remain in a fixed position on top and around the ear of the user. The ear hook further maintains the BCT of the pod in a fixed position that provides high quality audio for the user. For example, the BCT extending through the ear hook may contact the crease where the auricle, or pinna, of the user's ear connects to the user's head. In other examples, the BCT may directly contact the cartilage of the auricle of the user's ear, or may be secured against the skull of the user. The ear hook can similarly maintain a BCT plate coupled to the BCT in a fixed position.

The ear hook may include a channel extending from a first end of the hook to a second end of the hook. In one example, the channel is an open channel with first and second walls extending away from an interior base of the channel. The elongated channel can include a flange positioned between the first and second ends of the hook. The first and second

opposed walls further include an attachment mechanism, such as retaining channels, positioned on each of the respective first and second opposed walls.

The ear hook can be removably attached to the pod of the audio device. The first and second walls of the flange can be positioned to overlie the respective first and second sides of the pod, so as to form an exterior housing for the pod. In one example, the first retaining channel in the first wall of the flange of the ear hook can engage with protrusions extending from the corresponding first wall of the pod. Similarly, second retaining channels in the second wall of the flange can be engaged with protrusions extending from the second wall of the pod. The first and second retaining channels, as well as the retaining members can be configured so that a snap-fit connection is formed when the ear hook and pod are joined together. The snap-fit connection can make it easy to remove and reattach the ear clip to the pod.

The flange may further include an opening sized to receive at least a portion of the pod that will contact body of the user. In one example, a bone transducing plate coupled to a BCT may extend through the opening in the ear hook so as to be in contact with the user. When joined together, the ear hook keeps the bone transducing plate in sufficient contact with the user. The bone transducing plate can be in contact with the cartilage in the ear of a user, as well as the user's mastoid, near the back of the user's head behind the ears. In other examples, the BCT may directly contact the user.

The aforementioned example hooks may be secured to the pod using other types of connections or connection configurations. For example, in other embodiments, the ear hook may instead have protrusions and the pod may include retaining channels sized to receive the retaining members. Additionally, each ear hook may include a plurality of protrusions and the pod may include a plurality of corresponding retaining channels. Similarly, if it is desired to

form a more permanent connection, the ear hook can be permanently attached to the pod, such as by an adhesive or the like.

A material comprising the ear hook can be selected to help to secure the pod to the ear hook, as well as comfortably maintain the pod and BCT in a fixed position adjacent an ear of a user. For example, the ear hook may be comprised of a dense material to ensure that the pod remains secured to the ear hook and the ear of a user, as well as maintains the BCT in a fixed position against the skull and/or cartilage of the auricle or pinna of the user. In some examples, the density of the material may range from 5000 to 10,000 kg/m³. The density may also be greater than 1175 kg/m³. Examples of dense materials that can comprise the ear hook can include stainless steel, gold, sterling silver and other metal alloys. The ear hook may also be further comprised of biocompatible materials that will allow for a user to wear the audio device for extended periods of time.

Additionally or alternatively, a material with the ability to flex or that is flexible or resilient to allow for attachment of the ear hook to the pod can be selected. In one example, the ear hook may be comprised of a resilient material or the material comprising the ear hook can be cured to provide the needed resilience in the ear hook. Examples of resilient material can include stainless steel, such as SUS316. This can allow for the user to pull the first and second walls of the hook apart to disengage the ear hooks from the pod without deforming the ear hook. The resilient first and second walls will return to their original positions once the force used to pull the first and second walls apart is released. In this regard, the ear hook may possess its own spring force.

The features described above provide for a modular audio system. The ability for the ear hook to be removably attached to the pod allows for ear hooks of various sizes and shapes to be compatible with one standard pod. This allows for the users to have a more custom fit.

Users can purchase a set of ear hooks that are the same size or can select two different sized ear hooks compatible to each ear of a user. Providing the user with the ability to select a hook that is adapted to the specific size and shape of the ear of a user provides greater comfort to the user, as well as provides for better contact of the bone conduction transducer with the user. A user may also choose to coordinate one or more ear hooks with an outfit of the user. For example, a user may select a gold pair of ear hooks, such as hooks formed from 14K gold, if the audio device system will be used during a formal event.

An example audio device system 10 is illustrated in FIGURE 1. The audio device system 10 can include various components, including a weighted plug or pendant 60, an audio device 30, and one or more ear hooks 100. As will be discussed in more detail herein, the audio device 30 can comprise a pod 40 that houses a bone conduction transducer (BCT) 42 and other electronic components of the audio device system 10. The ear hooks 100 can be removably attached to the pods 40 and the pair of ear hooks 100 can be respectively positioned at first ends of a cable 50 and the pendant 60 can be positioned at an opposed second end of the cable 50. The ear hooks 100 can wrap around the rear of the ear of a user. Due to the configuration of the ear hook 100 and pods 40, the pods 40 of the audio device 30 can be removably attached to ear hooks 100 of varying sizes.

An example ear hook 100 is shown in FIGURES 2A and 2B. For ease of discussion, reference will be made to a single ear hook 100, but it is to be understood that both ear hooks 100 in the audio device system 10 may include the same features. The ear hook 100 may be designed to ergonomically fit on the user's ear. The ear hook 100 may be C-shaped and have a curved profile. The curve may extend from a first end 102 to a second 104 of the ear hook 100. An opening 106 may be positioned between the first and second ends 104. The opening may be in the shape of at least a portion of the BCT housing, such as an elongate oval, and be

located where the ear hook 100 will contact the back of the user's ears or a higher or lower portion of the ears. For example, the opening 106 may be anywhere within a range from the top of a user's ear to 90 degrees down from the top of the user's ear.

A central channel may be provided within the ear hook 100. For example, a central channel 108 may be an open and elongated channel extending along an entire length of the ear hook 100. A first wall 110 and a second wall 112 each extend away from an interior base 114 to form the central channel 108. Central channel 108 may have a substantially continuous interior surface 118. A substantially continuous exterior surface 120 may also extend along the length of the ear hook 100 between the first and second ends 102,104. Central channel 108 may be an open channel, allowing for both the interior surface 118 and exterior surface 120 to remain exposed. Opening 106 extends through the interior base 114 of the central channel 108, as well as through the interior and exterior surfaces 118,120. A peripheral edge 121 is formed along the outer perimeter of the opening 106. In other examples, the central channel 108 may not extend along the entire length of the ear hook between the first and second ends 102, 104. The central channel 108 may instead be only provided along certain portions of the ear hook.

The ear hook 100 may include a pair of flanges positioned between the first and second ends 102,104 of the ear hook 100. In one example, the pair of flanges 116A,116B are identical. Flange 116A may include a first flange wall 117 and flange 116B may include a second flange wall 119. The first flange 116A may be integrally formed with the first wall 110 of the ear hook 100 and the flange 116B may be integrally formed with the second wall 112 of the central channel 108. In this configuration, first and second flange walls 117,119 may be a subsection of first and second walls 110,112 of the ear hook 100. Flanges 116A,116B can each extend a length L1 that is greater than the length L2 that the remainder of the first and

second walls 110,112 extend. The flanges 116A,116B may have a generally rectangular shaped profile that will coincide with a profile of the pod 40, but flanges 116A,116B can take on any shape that may be desired.

FIGURE 2B provides another view of the ear hook 100, with the second wall 112 and second flange 116B facing outward. As shown in this view, the ear hook 100 may be symmetrical. The various features of the ear hook 100 along the first and second walls 112 may be mirror images of one another. In other examples, the flanges 116A,116B may be separately manufactured and attached to the ear hook 100.

A first attachment mechanism may be provided on the ear hook 100 to provide an interconnection with another device. For example, the attachment mechanism may be one or more retaining channels provided within each of the flanges 116A,116B of the ear hook. In one example, as shown in FIGURE 3, the ear hook 100 further includes first and second retaining channels 122A,122B disposed within the interior surface 118 of the flanges 116A,116B. The first retaining channels 122A may be positioned within the first flange wall 117 and the second channel 122B may be positioned within the second flange wall 119. The retaining channels 122A,122B are elongated and extend along a length of the flanges 116A,116B. The second retaining channel 122B positioned within the flange 116B may have a depth D and a width W that is sized to receive a corresponding mechanism on the pod 40, to which it will be attached. The second retaining channel 122B includes first and second sidewalls 124,126 joined together at a base 128. The outer peripheral edge 121 of the second retaining channel 122B is formed at the intersection between the first and second sidewalls 124B,126B of the retaining channel 122B and the interior surface 118 of the ear hook 100. The outermost edges 132B,134B of the retaining channel 122B may be angled from the outer perimeter 122B toward the base 128B of the retaining channel 122B to assist with ease of

insertion of the pod 40 during assembly. The first retaining channel 122A in first flange 116A may be identical and include the same features as retaining channel 122B in the second flange 116B. For example, first retaining channel 122A includes first and second sidewalls 124A, 126A, as well as ends 132A, 134A. In other examples, the first retaining channel 122A may differ from the second retaining channel 122B.

The pod 40, also shown in FIGURE 3, can house some of the electronic components of the audio device system 10. The pod 40 can include at least an outer pod housing 144 and the BCT 42. For example, the pod 40 may be pill-shaped, or a generally long oval shape, and may have surfaces that are concave to fit the curvature of the backs of the user's ears, such as the crease where the auricle of the user's ear connects to the user's head. The pod housing 144 can include a first side surface 146 and an opposed second side surface 148, as well as a first outermost end 143 and a second outermost end 145. A rear surface 147 extends along an entire length of the pod 40 and joins the first and second side surfaces 144, 146 together. The pod housing 144 may be shaped to fit within the central channel 108 extending along the length of the ear hook 100 and flanges 116A, 116B, as well as to fit behind the ear of a user when in use. In this example, the pod housing 144 does not fully enclose all interior components of pod 40, such that one or more internal components of the pod 40 remain exposed. In other examples, the pod 40 may be sealed off in order to be water-proof or sweat-proof.

The BCT 42 housed within the ear pod 40 includes a surface 44 that will be placed into contact with the ear of a user, when joined with the ear hook 100. BCT 42 may be further connected to one or more processors, a circuitry board, a battery, a memory, one or more sensors, a microphone, an amp, and/or other components within the housing 144. One or more of these components may also be located remotely from the BCTs 42.

The pod 40 can include a second attachment mechanism that can interconnect with the first attachment mechanism of the ear hook 100. For example, pod 40 may include a pair of retaining members 150A,150B (FIGURE 4) positioned on opposed sides of the ear pod 40. The retaining members can interlock with respective retaining channels 122A,122B in the corresponding flanges 116A,116B of the ear hook 100.

FIGURE 3 illustrates a first retaining member 150A of the pair of retaining members. First retaining member 150A extends along the first surface 146 of the pod 40. Retaining member 150A may be elongated and include a first retaining wall 152A, a second retaining wall 154A, and a retaining surface 156A that forms top surface 158A of the retaining member 150 and extends between the first and second retaining walls 152A,154A. The outermost ends 160A of the first retaining member 150A taper from the top surface 158A toward the first side surface 146 of the pod housing 144. The ends 160A can form smooth and curved edges. The first retaining member 150A is sized to interlock with the retaining channel 122A in the first flange 117 of the ear hook, as discussed in more detail below.

FIGURE 4 illustrates the second retaining member 150B disposed at the second surface 148 of the pod 40. In this example, second retaining member 150B is identical to the first retaining member 150A and possesses the same characteristics as the first retaining member 150A. For example, second retaining member 150B also includes a first retaining wall 152B, a second retaining wall 154B, a top surface 156B, and edges 160B. In other examples, the first and second retaining members 150A,150B can differ. The second retaining member 150B is sized and configured to interlock with the retaining channel 122B in the second flange wall 117 of the ear hook 100.

With reference to the second retaining channel 122B illustrated in FIGURE 3 and the second retaining member 150B illustrated in FIGURE 4, the second retaining channel 122B in the

second wall 112 of the second flange 116B can engage second retaining member 150B disposed at the second side surface 148 of the pod housing 144. When the second retaining member 150B is engaged with the corresponding retaining channel 122B of ear hook 100, the first retaining wall 152B of the second retaining member 150B is positioned adjacent the respective first wall 124B of the retaining channel 122B. Ends 160B of the first retaining member 150 are adjacent ends 132,134 of the retaining channel 122B. Similarly, the first retaining channel 122A in the first flange wall 117 can be engaged with the first retaining member 150A disposed at the first side surface 146 of the pod housing 144. The first retaining member 150A can be engaged within the retaining channel 122A in a similar way that the second retaining member 150B is engaged with the second retaining channel 122B.

FIGURE 5 provides an example of the ear hook and pod joined together. As shown, at least a portion of the pod 40 may be exposed through the opening 106 when the ear hook 100 and pod 40 are secured together. A BCT plate 166 coupled to the BCT 42 may extend through the opening 106 in the ear hook 100. In this example, the top surface 44 of the BCT plate 166 extends upward and away from the exterior surface 120 of the ear hook 100. This can ensure that the BCT plate 166 is in sufficient contact with the rear of the user when worn. In one example, the ear hook 100 can position the BCT plate 166 against the rear of the ear of the user so that the BCT plate 166 directly contacts the cartilage of the pinna or auricle of the ear.

The BCT 42 may provide audio to the user by vibrating against the user's cartilage and/or skull. Bone conduction requires an amount of contact force against the user in order for the vibration of the BCT 42 to reliably cause a same or similar vibration of the user's cartilage and/or skull and, ultimately, the user's inner ear, thereby providing clear audio output. In other examples, the BCT 42 may directly contact the user without the use of an intermediate

plate. In still other examples, the opening 106 of the ear hook 100 may be positioned at other points along the ear hook 100, including at the top of the ear hook closer to the first end 102 or towards the bottom of the ear hook 100 closer to the second end 104, or anywhere therebetween. This enables the BCT plate 166 to be positioned at any point along the ear of the user.

The housing of the pod 40 can be sized to fit within the central channel 108 formed between the flanges 116A,116B. Exposed portions of pod 40 can be enclosed by the first and second flange walls 117, 119. The outer edge 113 of the flange 116A can be flush with the outermost surface 147 (FIGURE 3) of the pod housing 144. In other examples, the outermost surface 147 of the pod housing 144 may be recessed below the outer edge 113.

In some examples, portions of the ear hook 100 may be configured to move in a lateral direction to accommodate the ear pod 40. FIGURE 6 illustrates a schematic plan view of the rear of ear hook 100 and flanges 116A,116B looking into the central channel 108, as well as lateral movement of the flanges 116. First and second flange walls 117,119, which in this example coincide with first and second walls 110,112 of ear hook 100, are biased toward one another. First and second flange walls 117,119 are configured to move against the biasing force in an opposite direction away from a central axis A of the ear hook 100, as well as away from one another. As shown, first flange wall 117 can be moved in a lateral direction D1 and the second flange wall 119 can be moved in a lateral direction D2. First flange wall 117 can move from an at rest or stationary position P1A to an expanded position P1B. Similarly, the second flange wall 119 can move from an at rest or stationary position P2A to an expanded position P2B. Movement of the first flange wall 117 into expanded position P1B increases the size or width W2 of the central channel 108 by respective a length $\Delta 1$. Similarly, movement of the second flange wall 119 into expanded position P2B increases the size or

width W2 of the central channel 108 by respective length $\Delta 2$. $\Delta 1$ and $\Delta 2$ can be the same length or different lengths. The first and second flange walls 117 and 119 need only move respective distance or lengths $\Delta 1$ and $\Delta 2$ to increase the size of the central channel 108 to a width W2 that is sufficiently wide enough to receive the ear pod 40 within the central channel 108. In some examples, other portions of the first and second walls 110,112 will also move or deflect when the first and second flange walls 117,119 are moved in a lateral direction.

A snap fit connection may be formed between the ear hook 100 and pod 40 to removably secure the pod 40 within the ear hook 100. In this example, the snap fit connection may be formed between the first and second retaining members 150A,150B of the pod 40 and the retaining channels 122 of the ear hook 100, as discussed in further detail herein.

The first and second flange walls 117,119 can be moved into positions P1B, P2B when a force is applied to the first and second walls 110,112, such as when the pod 40 is pushed into the ear hook 100. The flanges 116A,116B are configured to wrap around the respective first and second surfaces 146,148 of the pod 40. As first retaining member 150A on the first side surface 146 of the pod 40 and second retaining member 150B on the second side surface 148 of pod 40 are placed into central channel 108, each of the retaining members 150A,150B exert an outward force on respective first and second flanges 116A,116B. First retaining member 150A can exert a force against the first flange wall 117 of the ear hook 100. The second retaining member 150B disposed at the second side surface 146 of the pod 40 can exert a force against the second flange wall 119. This places the first and second walls 110,112 into position P1B and P2B (FIGURE 5.)

The first and second retaining members 150A,150B will continue to exert a force onto the respective first and second walls 115,117 of respective flanges 116A,116B until the first and second retaining members 150A,150B are positioned within respective retaining channels

122 in the first and second sidewalls 110,112 of the ear hook 100. When each of the retaining members 150A,150B are engaged and positioned within the corresponding retaining channels 122A,122B, retaining members 150A,150B no longer exert a force against the first and second sidewalls of the flange 116. The first and second flange walls 117,119 may bias back towards one another so that the first and second sidewalls 117,119 of the ear hook 100 will move back towards their original positions P1A and P1B (FIGURE 5) to form a snap fit connection.

When it is desired to detach the pod 40 from the ear hook 100, an external force may again be applied to move the first and second sidewalls of the flange 116 in a lateral direction. For example, a user may pull the first and second walls 110,112 of the flange 116 of the ear hook 100 away from one another and into at least a position P1B, and P2B (FIGURE 5) so that the first and second retaining channels 120A,120B are disengaged from the first and second retaining members 150A,150B. When the first and second retaining members 150A,150B are no longer positioned within the retaining channels 122A,122B, the pod 40 can be easily withdrawn and removed away from the channel 20 of the ear hook 100. When the force applied to the first and second flange sidewalls 117,119 is released, the first and second sidewalls 117,119 will bias back toward their original or at rest position.

The aforementioned example ear hook 100 may be secured to the pod 40 using other types of connections or connection configurations. For example, in other examples, the ear hook may instead have retaining members 150 and the pod 40 may include retaining channels 122 sized to receive the retention members. Additionally, each ear hook may include a plurality of retaining members 150 and the pod 40 may include a plurality of corresponding retaining channels 122. The pod 40 and ear hook can be designed to have a press fit or interference fit

with one another. Similarly, if it is desired to form a more permanent connection, the ear hook can be permanently attached to the pod 40, such as by an adhesive or the like.

The pod 40 can be further configured to form an additional or alternative securing connection between the portion of the ear pod 40 extending through the opening 106 in the ear hook 100. For example, the opening 106 of the ear hook 100 can be sized to be slightly smaller than the portion of the BCT 42 or bone conduction transducer plate 166 extending through the opening or adjacent the opening to provide for an interference fit between the two parts. In other examples, a snap-fit connection can be formed between the opening 106 and the BCT 42 or bone conduction transducing plate 166 extending therethrough.

Spring elements can additionally or alternatively be used to provide resilience when the hook is comprised of a stiff or rigid material. Tension springs may be provided on the pod housing 144 that directly face the ear hook 100. For example, tensions springs can be positioned anywhere along the outer surface of the pod housing 144, such as on upper and lower portions of the front surfaces of the pod 40, along edge surfaces of the pod 40 or combinations thereof. The tension force from the springs can help to ensure a secure fit between the ear hook and the pod 40.

FIGURE 7 illustrates a schematic view of the audio device system 10 when worn. In this example, each of the ear hooks 100 alone can secure the BCT 42 to the head of the user. For example, the ear hook 100 may position the BCT 42 against the cartilage or the pinna or auricle of the ear. The ear pod 40 and BCT 42 can be connected together through cables 50 positioned in front of the user. The audio device system 10 can further include a weighted pendant 60 positioned at the opposed ends of the cables 50. The ear hooks 100 can also support the weight of the pendant 60, which may also be positioned in front of the user.

When worn, the ear hook 100 may naturally rest at the top of a user's ear. The majority of the force of the ear hook 100, without more, is downward into the top of the user's ear. A BCT 42 positioned away from the top of the user's ear, for example, 45 degrees or 90 degrees from the top, may not be able to provide enough contact force between the BCTs 42 and the user's head to provide clear audio output to the user.

The cables 50 may be designed to provide a torque to the ear hooks 100 and the BCTs 42 such that the BCTs 42 are pressed firmly against the user's ears. The positioning of the cables 50 can produce a torque which causes the BCT 42 attached to the ear hooks 100 to contact a portion of the user's skull or cartilage of the ear with increased contact force. The cables 50 may protrude from the BCTs 42 or portions of the ear hooks 100 at a particular angle with respect to a direction of gravity. The cable 50 may extend straight for a predetermined distance at the particular angle. When the cable 50 is weighted, for example by the gravitational force of a pendant 60 coupled thereto, the angle at which the cable 50 protrudes from the BCT 42 may cause a torque to be applied to the BCT 42, the torque in turn increasing a contact force between the BCT 42 and the user's skull and/or cartilage. Strain relief may be provided in the cables 50 at a point where the straight portion begins to curve. When compressive forces are applied to the cable 50, the angled position of the cable 50 will also prevent the ear hook from becoming unseated on the user's ear. For example, when the user turns his head or when the pendant 60 is resting on a surface and no longer applying a tensile force on the cable 50, the cable 50 may return to its resting angled position as opposed to translating the compressive force to the ear hook or BCT 42.

As discussed above, a pendant 60 may be attached to the cables 50 at the second end of the audio device 30. A mass of the pendant 60 may exert a force on the cables 50, thereby increasing the contact force between the BCTs 42 that extend through the ear hook and the

user's cartilage and/or skull. For example, the pendant 60 may weigh between 10 and 20 grams. The pendant 60 may house components of the audio device system 10 such as one or more processors, a circuitry board, a battery, a memory, one or more sensors, a microphone, and/or an amp that are connected to the BCTs 42. Other components may include a gyroscope, a compass, and user input controls, such as volume or play/pause controls, charging input, such input for a USB Type-C connector, and pairing mechanisms. Including these components in the pendant 60 not only allows for a sleeker design, but also provides the mass to the pendant 60 to provide the needed contact force between the BCT 42 and the user's cartilage and/or skull. The components in the pendant 60 may be connected to the BCTs 42 or other components in the pod 40 via wires running through the cables 50.

FIGURE 8 illustrates an enlarged schematic view of the ear hook 100 and pod 40 on the ear 280 of the user. Ear hook 100 may be c-shaped and curve along the back of the user's ear 280. For example, the ear hook 100 may contact the crease where the auricle, or pinna, of the user's ear connects to the user's head. The ear hook 100 may contact at least the user's zygomatic process and the user's mastoid process and/or other nearby portions of the temporal bone. The first ear hook may also contact the cartilage of the user's auricle. The ear hook 100 may therefore be tucked behind the helix 288, antihelix 290, and lobule 292 of the user's ear. Furthermore, the surface of the ear hook 100 may be shaped to accommodate the shape of the portions of the temporal bone and ear that it contacts. The opening 106 of the "C" may then open toward the front of the user's ears, such as near the tragus 294 and the lobule 292.

When worn, the ear hook 100 rests on the top 282 of the user's ear 280 and can remain in a fixed position on top and around the ear of the user. As discussed above, the ear hook 100 further maintains the BCT 42 of the pod 40 in a fixed position at the rear 284 of the ear of the

user so that high quality audio is provided to the user. For example, the BCT 42 extending through the ear hook 100 may contact the crease where the auricle 286, or pinna, of the user's ear connects to the user's head. In other examples, the BCT 42 may directly contact the cartilage of the auricle 286 of the user's ear, or may be secured against the skull of the user. The ear hook 100 can similarly secure a BCT plate 166 coupled to the BCT 42 in a fixed position against the head of a user, including the user's ear. The sound vibrations may be translated to the user's ear 280 through the contact between the BCT plate 166 and the user's ear 280. In other examples, the BCT 42 can be positioned at different locations along the ear of the user. For example, the BCT 42 can be positioned above or below a lateral plane intersecting the user's ear. As noted above, the weight provided by one or more components in the audio device system 10 can increase the contact force of the BCT 42 against the user's ear.

With reference to FIGURE 9, the ability to removably attach an ear hook 100 to an ear pod 40 and vice versa allows for an ear pod 40 to connect with ear hooks 100 of various shapes, sizes, and materials. This, in turn, provides the user with numerous options guiding the user's selection of a pair of ear hooks 100 to use with the ear pod 40. A user to select from a variety of sizes and shapes of the ear hook 100 to accommodate for the size and shape of the user's ear, as well as the subjective comfort of the user. For example, as shown, three sets of ear hooks 300, 310 and 320 are illustrated. The ear hooks 300, 310, and 320 slightly differ in size and shape. Ear hooks 300 have the same shape and size as the ear hooks previously discussed herein. Ear hooks 310 possess a more rounded shape. Ear hooks 320 possess a more elongated shape. Each of these ear hooks 300, 310, 320 have the same features previously discussed herein, including an attachment mechanism that can join with the attachment of the ear pod 340, such as a retaining member 350.

The different shapes and sizes may enable users with different sized and shaped ears to select an ear hook 100 which comfortably positions the BCT 42 near the user's skull or ear for optimum sound quality. For example, the ear hook 100 may position the BCT 42 against the cartilage or pinna of the user's ear. As mentioned above, a weighted pendant 60 or other force coupled to the BCT 42 may increase the contact force between the BCT 42 and the user's skull and/or cartilage of the auricle or pinna of the user's ear.

Ear hooks 300, 310, 320 may also be formed from different materials. A user may select ear hooks for their aesthetic look. For example, a user may select among gold, silver, pink, blue and the like ear hooks to match the ear hooks with an outfit the user is wearing.

Ear hooks may also be utilized to change the position of the BCT 42. For example, the opening 106 of the ear hook may be oriented toward the top of the ear, toward the bottom of the ear, or anywhere along the ear hook. This allows one to also select an alternate position for the BCT 42.

The ability of one or more different types and sizes of ear hooks 300, 310, 320 to be secured to the same ear pod 340 enables a user to select a pair of ear hooks that will provide the user with optimum comfort while wearing the ear hooks of the audio device system 10.

In the examples discussed above, relative positions such as lateral, longitudinal, horizontal, vertical, top, bottom, and the like are used for reference only and are not intended to be limiting with respect to particular positions of the elements they are used to describe.

Unless otherwise stated, the foregoing alternative examples are not mutually exclusive, but may be implemented in various combinations to achieve unique advantages. As these and other variations and combinations of the features discussed above can be utilized, the foregoing description of the embodiments should be taken by way of illustration rather than by way of limitation. In addition, the provision of the examples described herein, as well as

clauses phrased as “such as,” “for example,” “including” and the like, should not be interpreted as limiting the subject matter to the specific examples; rather, the examples are intended to illustrate only one of many possible embodiments. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present disclosure.

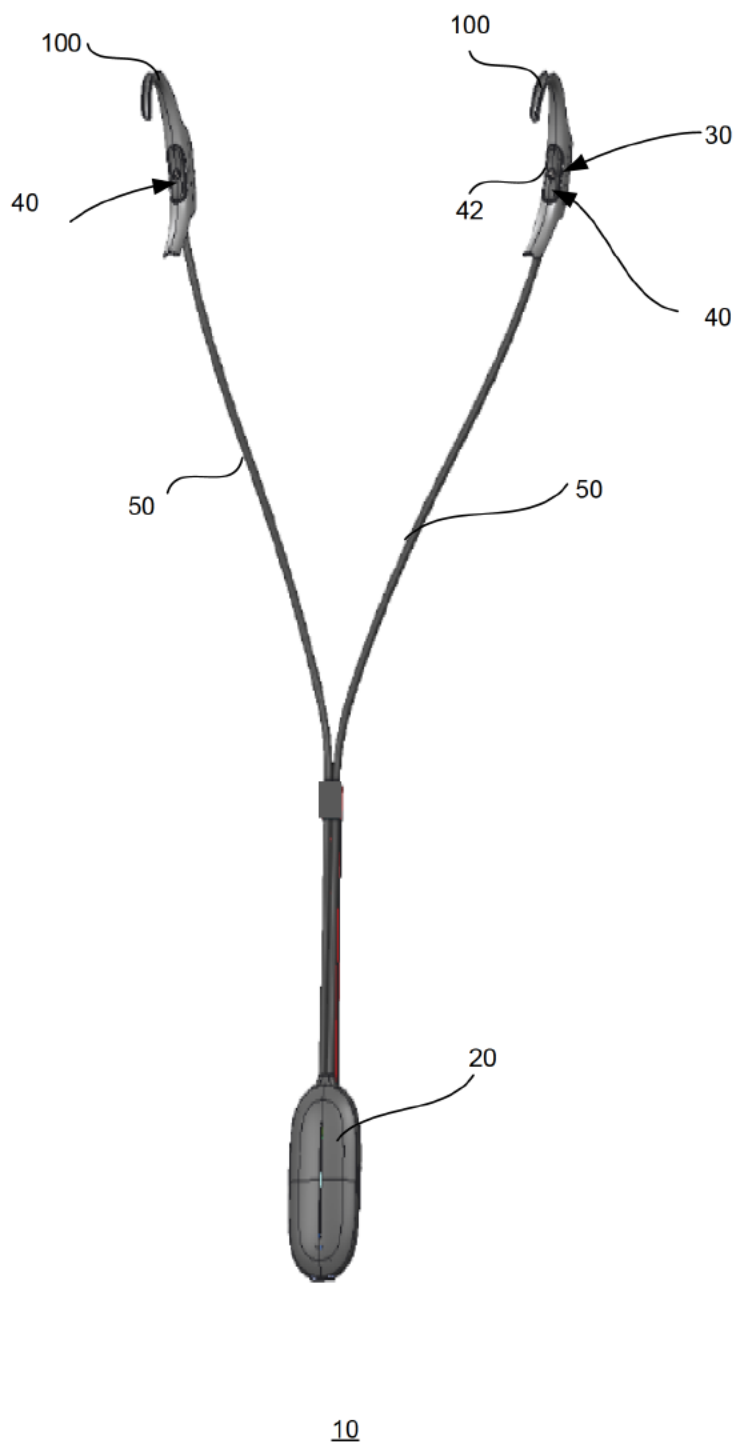


FIGURE 1

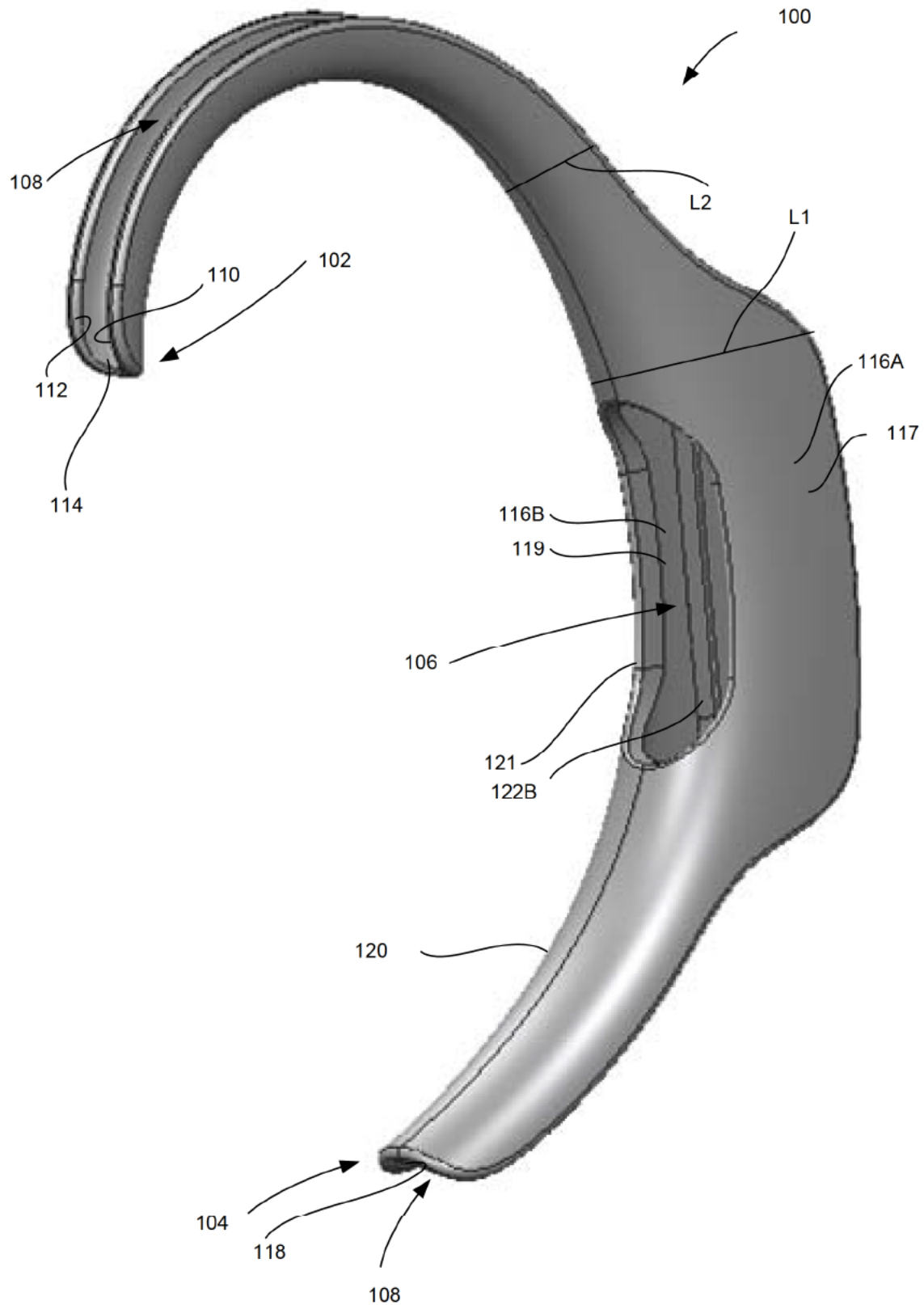


FIGURE 2A

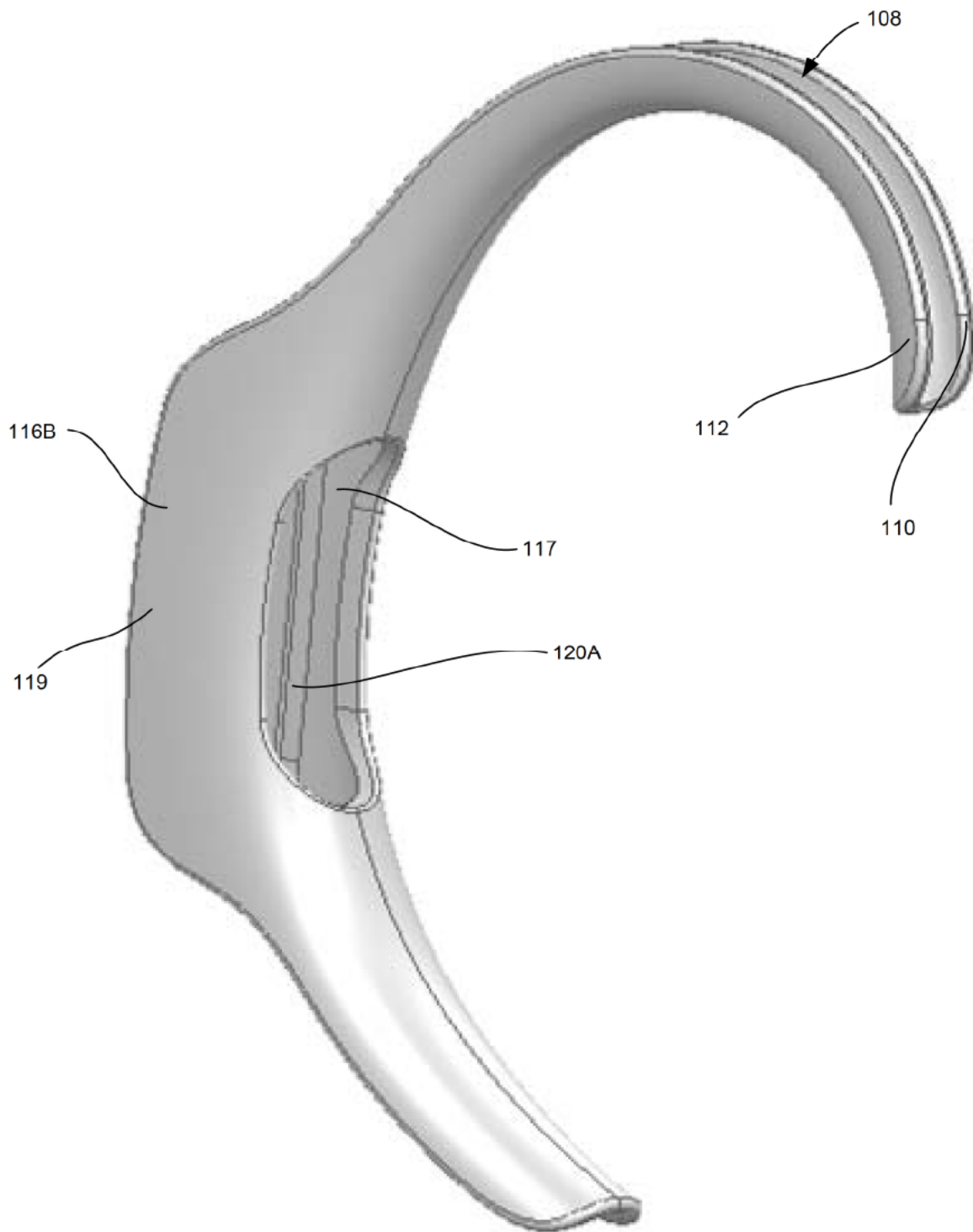


FIGURE 2B

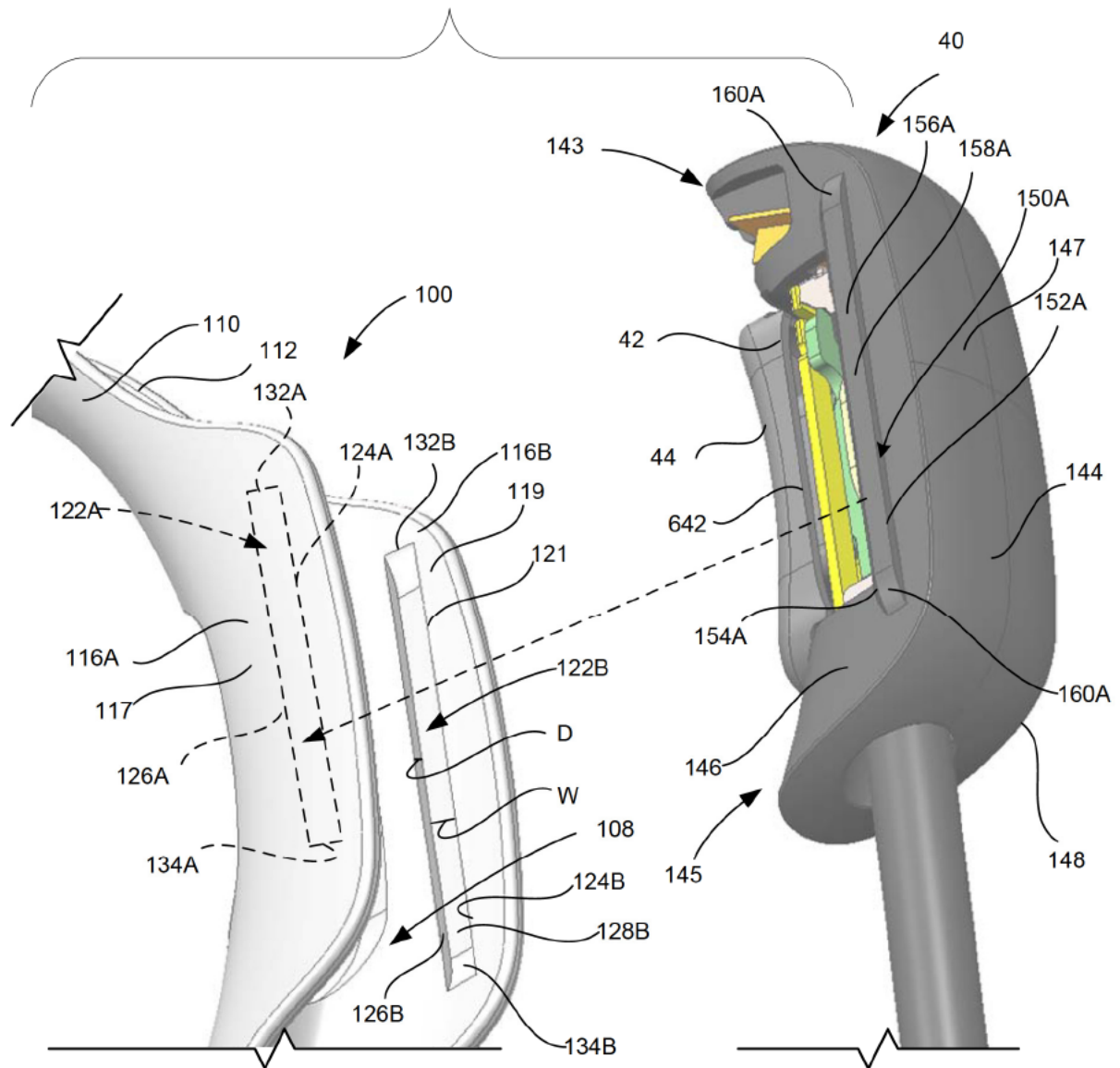


FIGURE 3

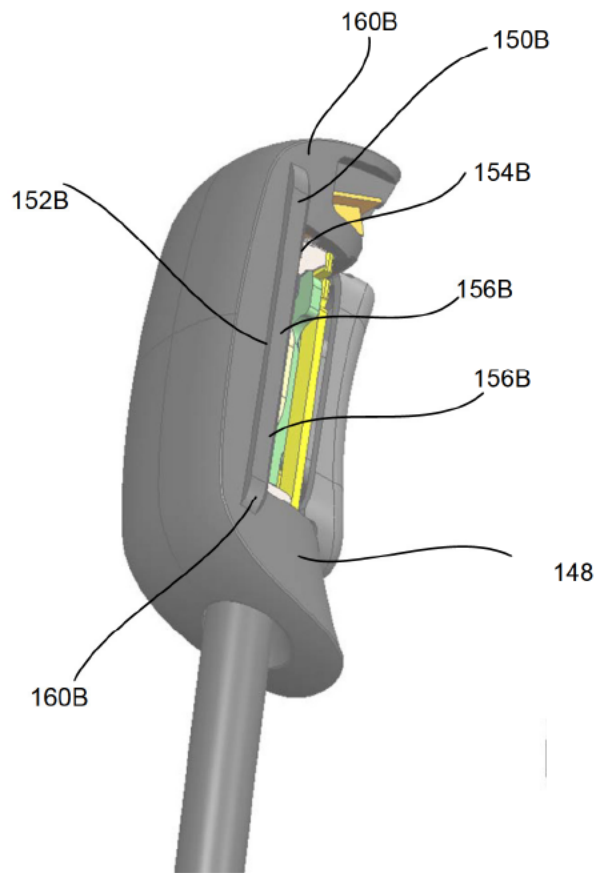


FIGURE 4

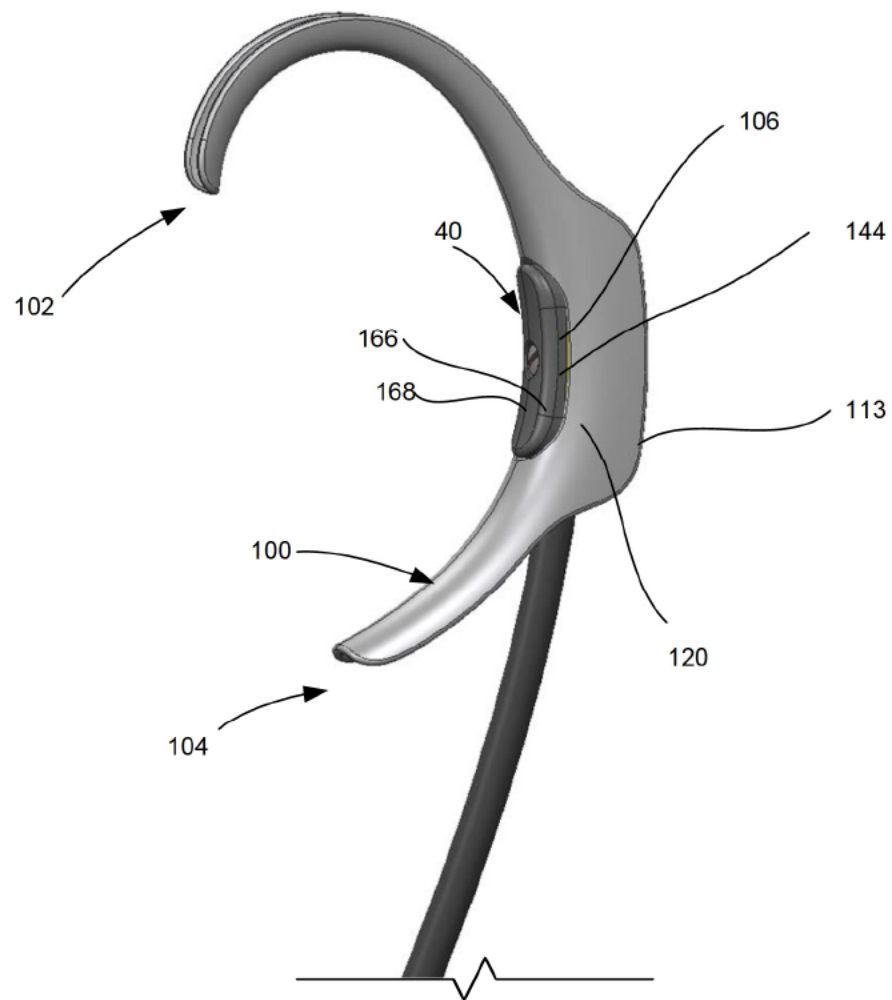


FIGURE 5

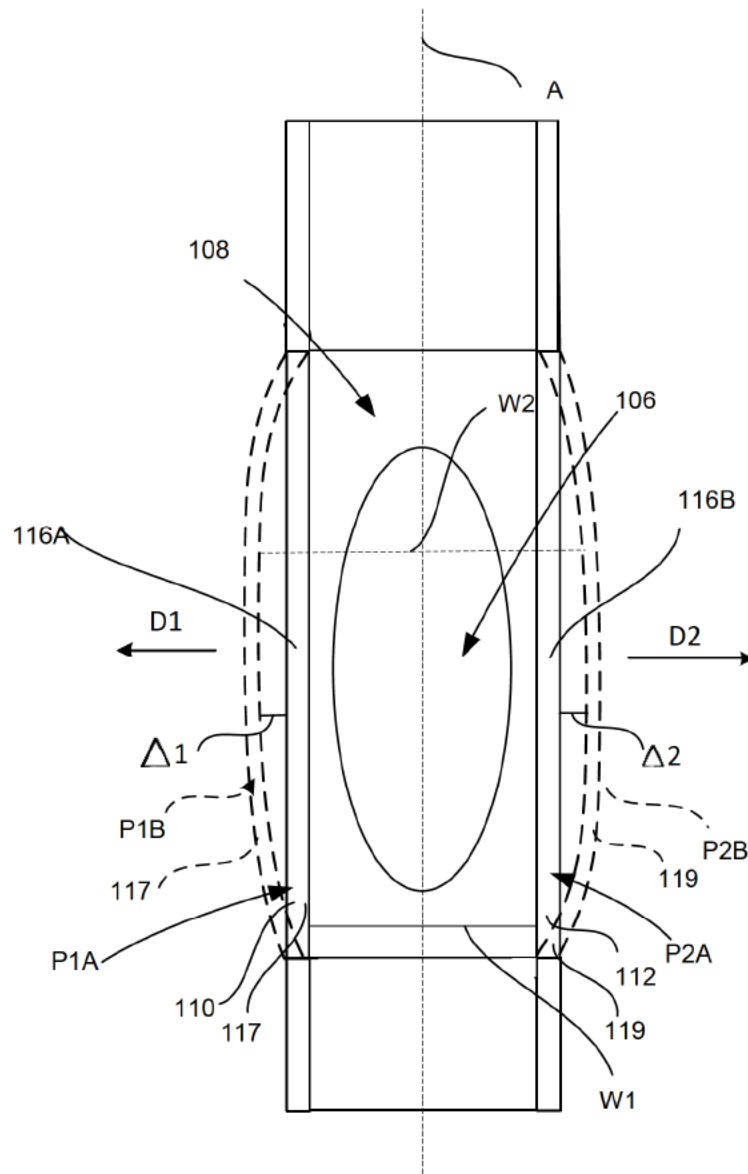


FIGURE 6

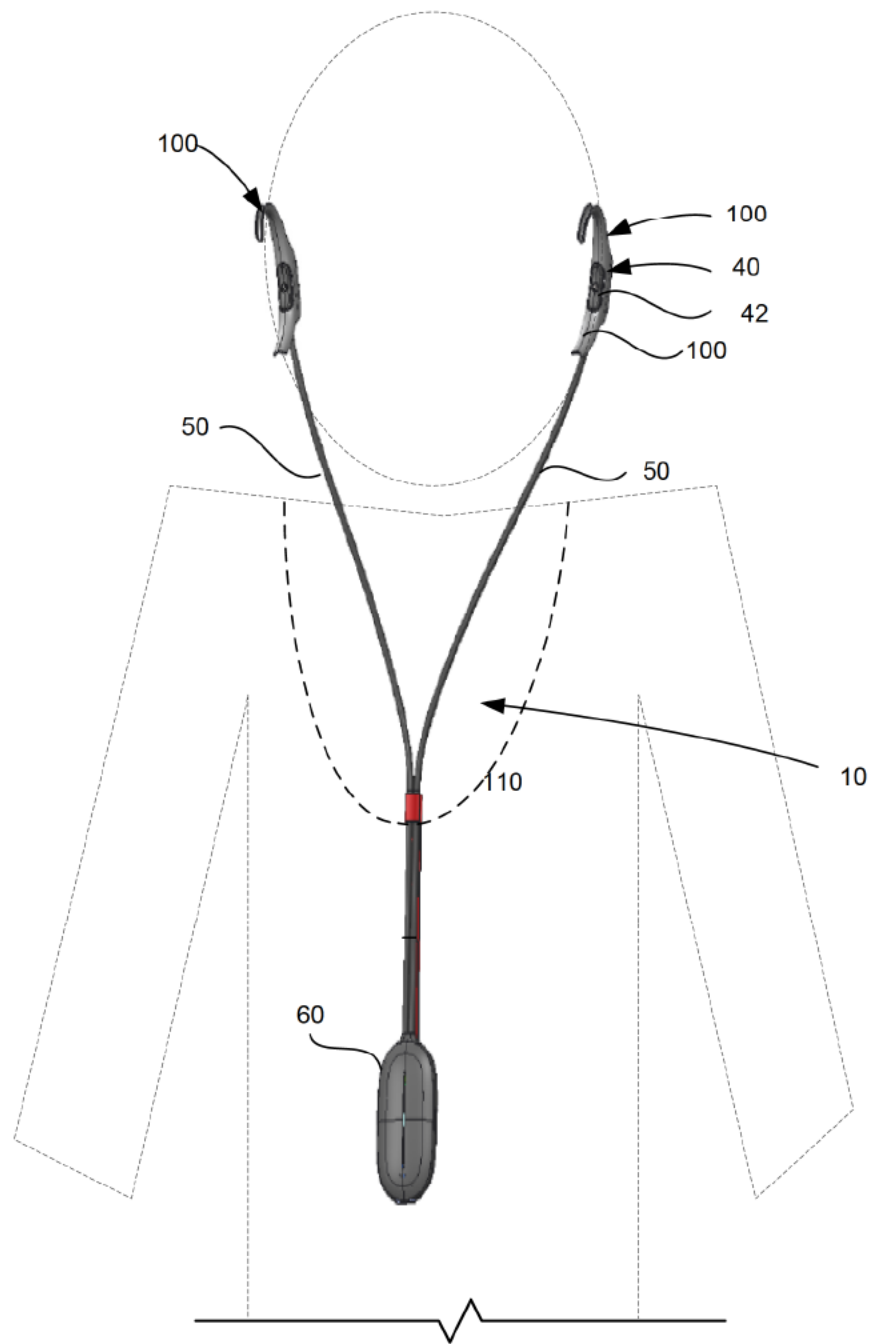


FIGURE 7

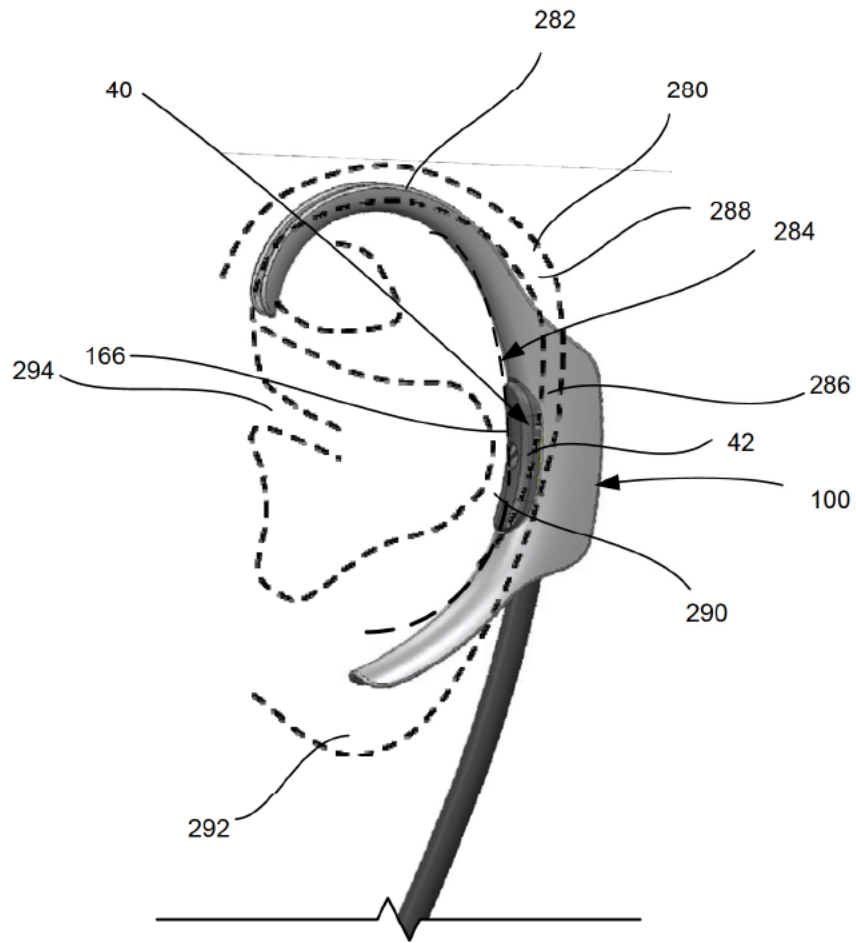


FIGURE 8

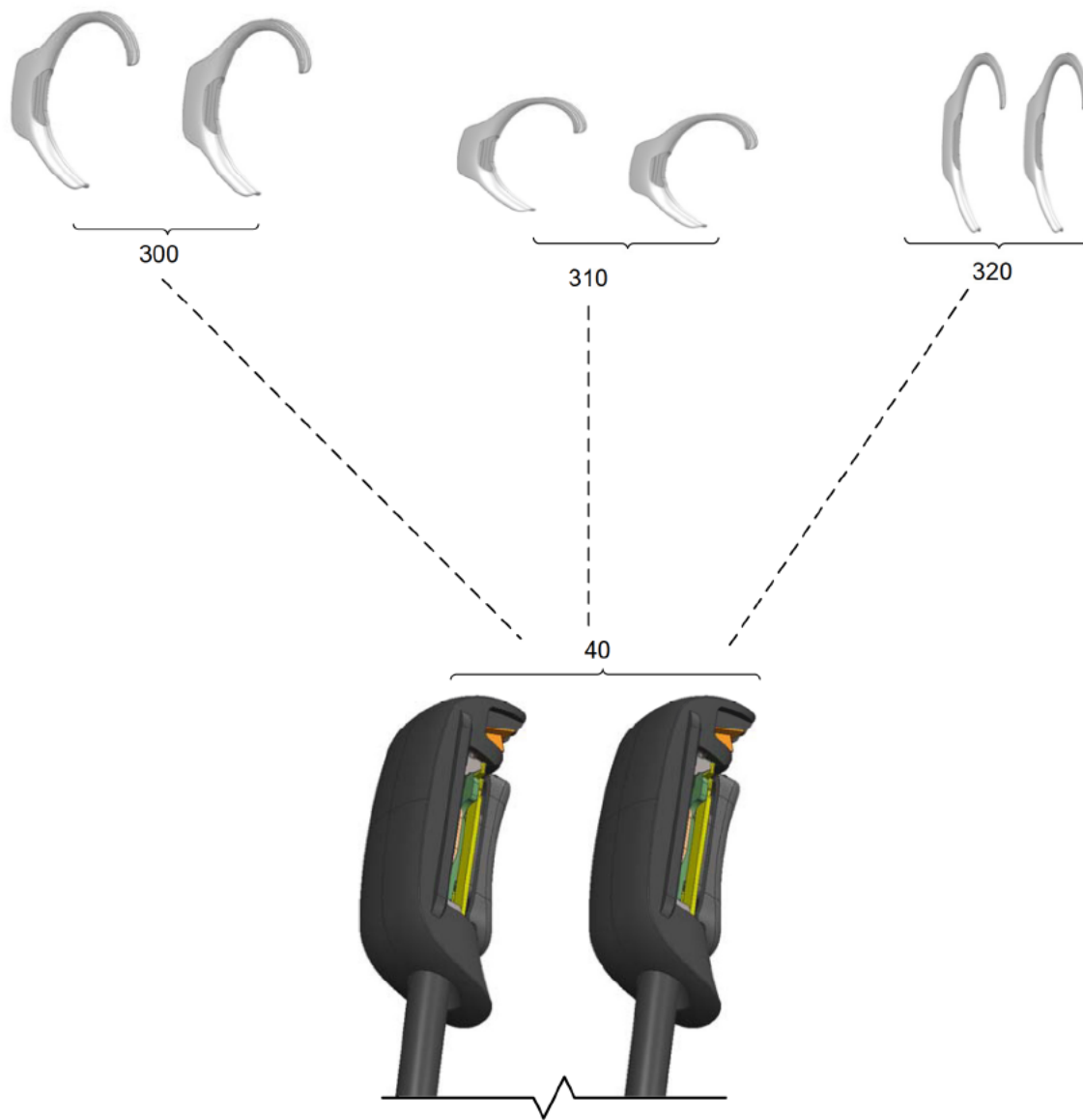


FIGURE 9